



University of Agronomic Sciences and Veterinary Medicine of Bucharest
Faculty of Horticulture

International Student Symposium “*Hortus Academicus*”

April 07, 2023, Bucharest, Romania

The Evolution of Strawberry Cultivation Technologies

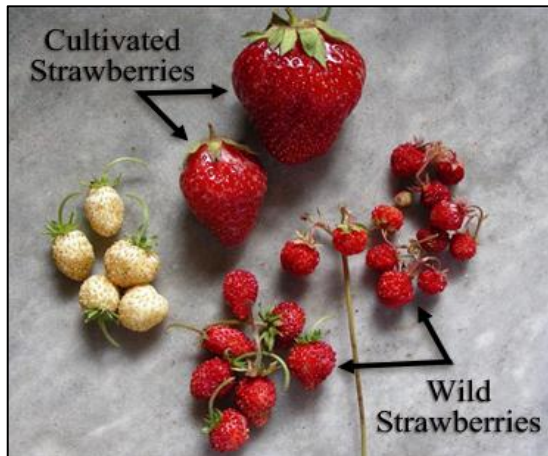
Authors names: Ailin Moloșag, Violeta
Alexandra Ion, Adrian Asănică, Liliana
Bădulescu, Viorica Lagunovschi-Luchian

Coordinator Professor: Viorica Lagunovschi-
Luchian

Introduction

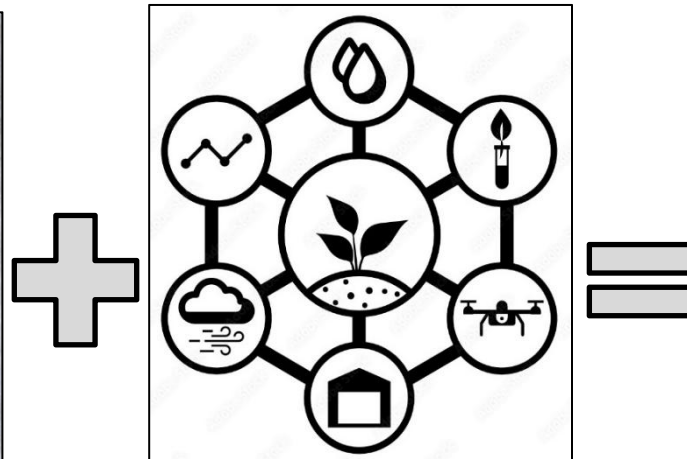
- Strawberry cultivation technologies -

- ❑ **Strawberry cultivation technologies** has developed along with the *evolution of variety assortment* and *advancements in technology*



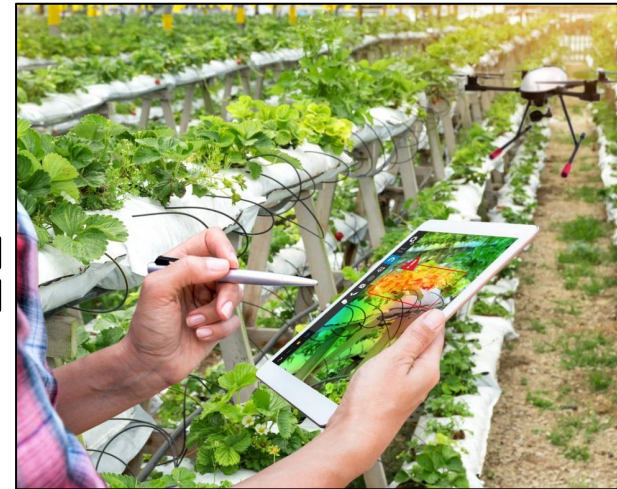
Source: <https://utah.agclassroom.org/matrix/lesson/519/>

Variety progress



Source: <https://stock.adobe.com/>

Technology progress



Source: <https://stock.adobe.com/>

Smart strawberry cultivation

Introduction

- Strawberry technological links -

❑ In *setting* the **cultivation technology** for a species, we *consider* all the **technological links**

❑ **Variety** of planting material



❑ **Cultivation system**



❑ **Irrigation**



❑ **Fertilization**



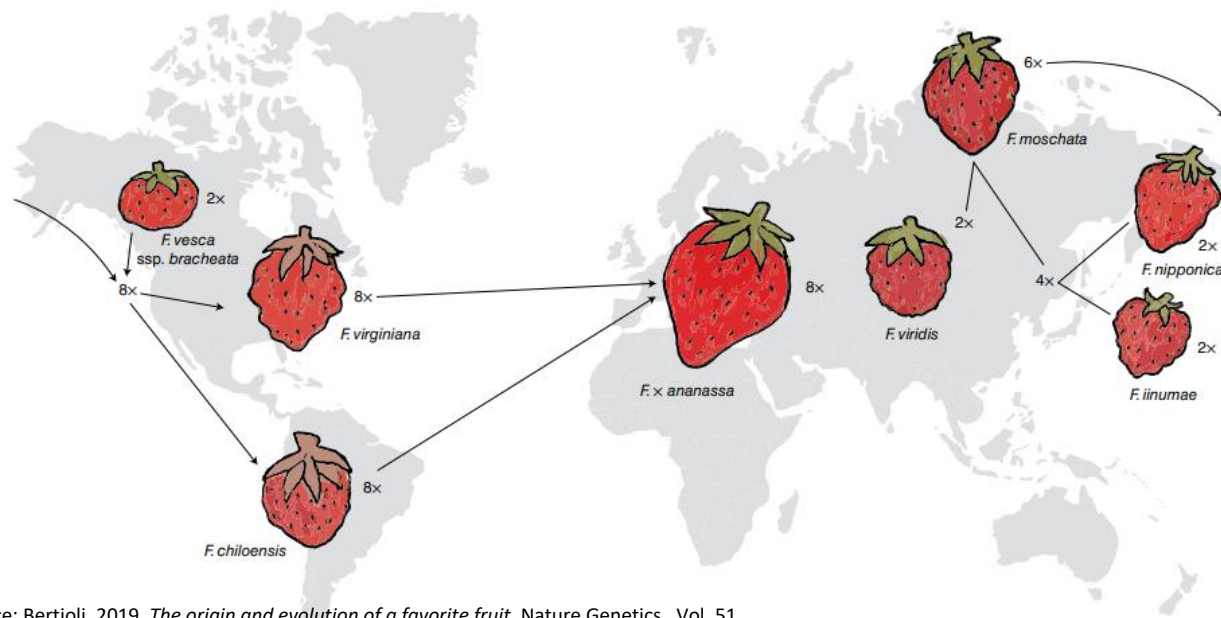
❑ **Crop protection strategies**



Introduction

- Strawberry varieties -

- ❑ Strawberry is considered to be one of the plants that have been **domesticated recently**, less than 300 years ago (Hardigan et al., 2021).
- ❑ The cultivated strawberry *Fragaria × ananassa* species is a **spontaneous hybrid**, which originated in Europe (the 18th century) and is the result of crossing wild allo-octoploid species *Fragaria chiloensis* and *Fragaria virginiana* (Edger et al., 2019).



Source: Bertoli, 2019. *The origin and evolution of a favorite fruit*. Nature Genetics , Vol. 51.

Schematic showing the hybridizations that gave rise to *Fragaria × ananassa*

Introduction

- Strawberry varieties -

- ❑ There are different types of varieties that have been developed within the species (Asănică & Hoza, 2013):

- ❑ one **harvest / year**,
require *short days* and
low temperatures for
flower formation

- ❑ **everbearing /
remontant**, *day
neutral varieties*
showing 2-3 waves of
maximum fruiting

Varieties:

‘Coral’, ‘Premial’,
‘Real’, ‘Magic’,
‘Benton’, ‘Senga
Sengana’, ‘Clery’,
‘Elsanta’



Source: <https://plantura.garden/uk/fruits/strawberries/types-of-strawberries>

Varieties:

‘Floral’, ‘Albion’,
‘Seascape’, ‘San
Andreas’, ‘Tribute’,
‘Bolero’, ‘Envie 2’,
‘Favori’, ‘Alinta’

Strawberries types

Introduction

- Growing systems -

☐ **Growing systems** can be classified according to *several criteria*

- ☐ the production's consumption purpose
 - ☐ crops intended for the production of fresh consumption
 - ☐ crops intended for the production for industrialization
- ☐ the type of soil / substrate
 - ☐ crops grown on the ground (traditional cultivation system)
 - ☐ crops grown on different substrates (mineral, organic, in nutrient solutions)
- ☐ the type of the plantation
 - ☐ classical / traditional
 - ☐ semi-intensive
 - ☐ intensive
 - ☐ superintensive

Introduction

- Farming practices -

- ❑ *The environmental impact of agricultural activities is thought to depend on the **farming practices** adopted by farmers (Valiante et al., 2019).*
- ❑ The farming practices (soil care and crop management) are different and depend on the cropping system. The most known are:

Colored plastic mulch on strawberry was tried by Shiukhy et al. (2015)



Source: Franquera, 2011

Influence of Different Colored Plastic Mulch on the Growth of Lettuce (*Lactuca sativa*)

Wheat straw and black polyethylene, two widely used practices in strawberry cultivation, tried by Muñoz et al. (2017)



Source: <https://www.homefortheharvest.com/mulch-for-strawberries/>

Straw Mulch

Introduction

- Growing systems -

- ❑ **Growing systems** can be classified according to *several criteria*



Source: <https://www.homefortheharvest.com/hill-system-strawberries/>

Double row raised beds system for indoor stawberry cultivation



Source: <https://www.krishisewa.com/index.php/crop-cultivation/263-strawberry.html>

Double row raised beds system for outdoor stawberry cultivation

As crop method/practice in both systems is used black plastic mulch

Introduction

- Growing systems -

- ❑ **Growing systems** can be classified according to *several criteria*



Source: <https://extension.oregonstate.edu/pub/em-9333>

Multiple low tunnels for strawberry production at the North Willamette Research and Extension Center in Aurora, Oregon



Introduction

- Growing systems -

- ❑ **Growing systems** can be classified according to *several criteria*



Source: <https://fff.hort.purdue.edu/article/evaluation-of-strawberry-varieties-for-high-tunnel-production/>

**Strawberries grown inside a high tunnel at
Southwest Purdue Agricultural Center
(April 16, 2016)**



Source: <https://fruitgrowersnews.com/article/high-tunnels-bring-crop-success-under-cover/>

**Michigan State University's Eric Hanson explains how
strawberries are being grown in bags of coconut core
imported from Malaysia**

Introduction

- The newest technologies on strawberry crop -



Source: <https://www.verticalfarmdaily.com/article/9248529/you-cannot-survive-without-data-anymore/>

Vertical farming (VF) in strawberry production



Source: <https://agronomy.com/best-hydroponic-strawberry-cultivation-system/>

NGS oscillating strawberry cultivation system



Source:
<https://sciencebusiness.net/network-updates/photonics-strawberry-picking-robots-gather-enough-fruit-wimbledon-1-week>

New harvesting techniques used in strawberry production

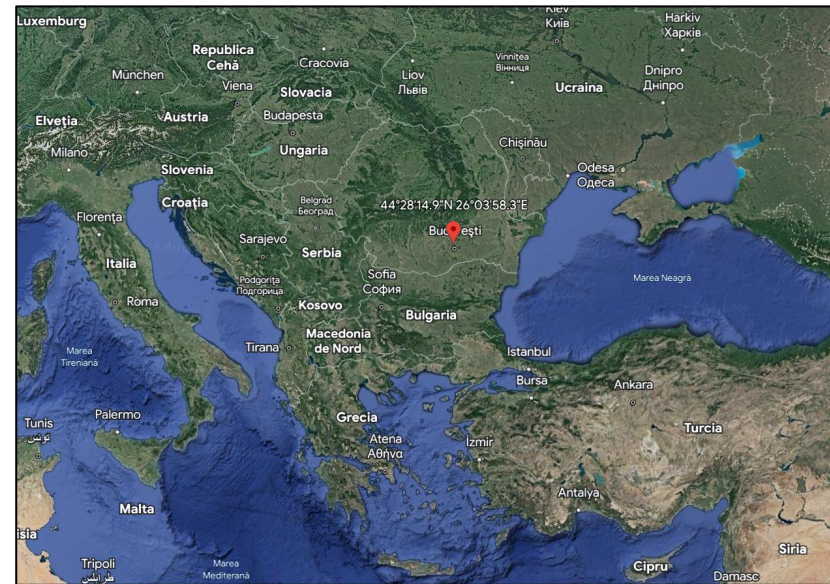
TAILORED HI-GROW TABLETOP SYSTEM FOR ADVANCED STRAWBERRY CULTIVATION

(Moloșag A., Ion V.A., Popescu D., Moț A., Frîncu M., Iliescu L.M., Asănică A.C., Bădulescu L.A., Pârvulescu O.C., Lagunovschi-Luchian V., 2022)

❑ The *aim* of this study was to *implement* a **hi-grow tabletop technology** for **strawberry** in the *USAMV of Bucharest experimental open field*.

❑ **Location:** The experimental field within the Faculty of Horticulture, USAMV of Bucharest - 44.4708° N and 26.0662° E (Asănică et al., 2017), was established in spring 2022.

❑ **Variety:** 'Albion'



Source: <https://earth.google.com/>

Location of Faculty of Horticulture, USAMV of Bucharest - 44.4708° N and 26.0662° E

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❑ IMPLEMENTING THE GROWING TECHNOLOGY

❑ Tabletop strawberry growing system



Tabletop growing system

a) structure for supporting the pot

b) pots placed on irrigation drains

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❑ IMPLEMENTING THE GROWING TECHNOLOGY

❑ Preparing the substrate for strawberry cultivation



Filling pots with peat

a) crushing the peat

b) pots with crushed peat



sphagnum peat
(OPM 540 W, Kekkilä-
BVB, Finland)

the required volume of
sphagnum
peat substrate for all 248
pots was 1.98 m³

peat was crushed by
hand

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❑ IMPLEMENTING THE GROWING TECHNOLOGY

❑ Selecting the seedling material

‘Albion’ variety is a typical *day-neutral strawberry cultivar* and produces fruit regardless of day length when treated appropriately (Shaw et al., 2006).

Because of their small dimensions (15-40 cm), the strawberries could *be grown successfully in pots, greenhouses or in large outdoors spaces* (Tudor et al., 2014).



Source:

[https://www.lecooke.com/Images/Berries_&_Vegetables/Strawberries/Albion-Strawberry\(RGB\).pdf](https://www.lecooke.com/Images/Berries_&_Vegetables/Strawberries/Albion-Strawberry(RGB).pdf)

‘Albion’ everbearing strawberry variety

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❑ IMPLEMENTING THE GROWING TECHNOLOGY

❑ Preparing and planting the strawberry plants

Dormant cold-stored plants of the 'Albion' cultivar were obtained from a commercial nursery (SC Strawberry Plants SRL, Tămășeu, Bihor, Romania).

Before planting, the plants were kept at 1°C in plastic bags, firmly closed at the top to prevent mold and premature development of the strawberry leaf rosette.

The roots were shortened to a length of about 10 cm, spread by hand to support their development, and immersed in a mixture of water and peat to prepare them for planting.

After preparing the plants, they were planted in the pots and irrigated throughout the day.



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❑ IMPLEMENTING THE GROWING TECHNOLOGY



Preparing and planting the strawberry plants
23rd of May 2022



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❑ IMPLEMENTING THE GROWING TECHNOLOGY

❑ Irrigation system installation

A drip irrigation system was used in this study. Drip irrigation involves dripping water onto the soil at very low flow rates (2-20 L/h) from a system of small diameter plastic pipes (emitters). After planting, the irrigation system was set to water 4 times a day.

❑ Fertilization requirements

Strawberry plants were fertilized according to their requirements and development of phenophases. Being an experimental field, different fertilization methods were applied considering the nitrogen requirements for optimal plant growth and development.

❑ Diseases and pest control

No plant protection products were applied.



Drip irrigation system

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❑ IMPLEMENTING THE GROWING TECHNOLOGY



Plant development of M (control) variant
6th of June 2022

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❑ FIRST YEAR PRELIMINARY RESULTS

- ❑ resisted the weather variations;
- ❑ the irrigation scheme proved to be effective, providing the plants with the necessary water;
- ❑ the fruit production obtained using this growing technology was in accordance with the data specified by the producer of 'Albion' variety;
- ❑ at the end of the season 81.4% of the plants had grown and developed;
- ❑ the plants began to bear fruit in June 2022 (2 months after planting), with a production peak in autumn (September 2022), but fruiting continued even at lower temperatures (November 2022).



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❑ FIRST YEAR PRELIMINARY RESULTS



Fruits development
4th of July 2022

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❑ FIRST YEAR PRELIMINARY RESULTS



Plant development of M (control) variant
1st of August 2022



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❑ FIRST YEAR PRELIMINARY RESULTS



Plant development of A variant
1st of August 2022



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❑ FIRST YEAR PRELIMINARY RESULTS



Plant development of B variant
1st of August 2022



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❑ FIRST YEAR PRELIMINARY RESULTS



Plant development of C variant
1st of August 2022



TAILORED HI-GROW TABLETOP SYSTEM FOR ADVANCED STRAWBERRY CULTIVATION

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❑ FIRST YEAR PRELIMINARY RESULTS



Plant development of D variant
1st of August 2022



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❑ FIRST YEAR PRELIMINARY RESULTS

Benefits of tailored hi-grow tabletop system

- ❑ the **presence of pollinating insects**, more insects being near the pots than at ground level.
- ❑ for an ecological approach, different plant species (e.g., asparagus, beans, peas, spinach, lettuce, garlic, onion, horseradish, rhubarb) can be sown under the raised beds, which can *improve soil fertility* by fixing nitrogen.
- ❑ **companion plants** (flower strips, trap plants or cover crops) are sources of nectar for antagonists and living mulches can increase biodiversity and strawberry crop productivity by *minimizing the development of pests* in the field.

Downsides of tailored hi-grow tabletop system

- ❑ in this experimental climate, the main **stress factors** were the high temperatures during the summer (when the substrate temperature exceeded 30°C) and direct solar radiation. (*Solution: optimization of the amount of irrigation water and the implementation of a shading system*)
- ❑ the implementation of the growing system *can be more expensive* than that of the conventional systems, but this technology can be **very profitable** due to the reduction of costs corresponding to water and fertilizer consumption, human resources, etc.

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❑ CONCLUSIONS

This study successfully implemented a tailored hi-grow tabletop technology for strawberry in the USAMV of Bucharest experimental open field.

Based on the developed technology, the ‘Albion’ strawberry plants grew vigorously and bore fruit throughout the experiment.

This growing technology will *allow experimentation with different fertilization treatments* and strawberry cultivars as well as an *evaluation of abiotic and biotic stress on plant growth*. Fertilizers obtained from marine residual materials, i.e., residues of fish, rockweed (*Ascophyllum nodosum*), and organic blue mussels (*Mytilus edulis*), will be tested to grow strawberries.

The technology can be easily adapted for other crops, e.g., salad, spinach, aromatic plants. Future research will be conducted to *improve the technology* with a shading system, which will increase the efficiency and production.

❑ **ACKNOWLEDGEMENTS:** This paper is part of the project 244/2021 ERANET-BLUEBIO-MARIGREEN, which has received funding from the European Union’s Horizon 2020 research and innovation program under agreement 817992 and Ministry of Research, Innovation and Digitization, CNCS/CCCDI - UEFISCDI, within PNCDI III. Special thanks to the private company ‘Fructe de 10’ for the assistance in the construction phase of the tabletop system.

Thank you for your attention



University of Agronomic Sciences and Veterinary Medicine of Bucharest

Faculty of Horticulture

PhDs in Horticulture (Engineering and Management of Plant and Animal Resources - EMPAR, I)

Ailin MOLOȘAG, ailin.molosag@horti.usamv.ro

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